INVESTIGATOR'S ANNUAL REPORT

National Park Service

All or some of the information provided may be available to the public

Reporting Year: 2000	**Park:** Shenandoah NP
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Permit#:
SHEN1999N-192

Park-assigned Study Id. #:
unknown

Project Title:
Implications Of Catchment Structure For Time-Varying Hydrological And Hydrochemical Response In A Forested Headwater Catchment

Permit Start Date: Jan 01, 2000	**Permit Expiration Date** Jan 01, 2001
Study Start Date: Jan 01, 1997	**Study End Date** Jan 01, 2002

Study Status:
Terminated before completed

Activity Type:
Research

Subject/Discipline:
Water / Hydrology

Objectives:
Catchment structure, including both surface topography and subsurface permeability structure, is an important determinant of the hydrological response of a catchment to precipitation events. Stream water chemistry is in turn influenced by time-varying flow paths through the catchment. Although much progress has been made in recent years in understanding the flow paths through catchments and how chemical composition of waters reflect these paths, the impact of different simplifying assumptions underlying current models have not been explored systematically. The goal of the proposed study is to develop a quantitative and predictive physically-based model of the hydrological response of a saprolite-granite catchment and to explore the importance of surface topography and subsurface structure in determining key aspects of catchment hydrochemical response.;Our study site is the 237-hectare catchment drained by the South Fork Brokenback Run (SFBR), on the north side of Old Rag Mountain, Shenandoah National Park, Virginia. A soil and saprolite regolith is developed on top of the Precambrian Old Rag granite that underlies the entire catchment. Observations made over the past three years at this site have motivated the proposed study: a transient perched water zone contributes stormflow to the stream; stream silica concentrations display a hysteretic concentration-discharge trajectory during storm events; silica concentrations in soil water display very little temporal variation, but tend to increase downslope; significant aqueous concentrations of silica, which vary systematically with depth, are reached within days after water contact with the rock.;The objectives of the proposed study are to:;o Develop a theoretical framework for quantifying transient, topographically-controlled water movement and chemical transport in the subsurface.;o Examine model sensitivity to hydrological and geochemical parameters; determine critical controls on concentration-discharge (c-Q) dynamics.;o Test this theoretical framework using a combination of hydrometric and tracer observations.;Quantitative analysis of coupled hydrological-geochemical processes in catchments is necessary to resolve important questions about biogeochemical transformations that impact water quality. The proposed studies will lead to a deeper knowledge of how catchment structure controls patterns of hydrochemical response.

Findings and Status:

The project started in September 1999. A Ph.D. student, Jeff Chanat, was recruited during the winter of 2000. He worked on the project in the summer of 2000 and started the Ph.D. program in September.

The main progress during the year was made on examination of model sensitivity to hydrological and geochemical parameters, to determine critical controls on concentration-discharge (c-Q) dynamics. We have one paper printed and two In press on the work.

The relationship between concentration (c) and discharge (Q) in a stream is one of the aspects of hydrochemical catchment response that has been used widely as a diagnostic. In particular, loops in the c-Q curve, commonly referred to as hysteresis loops, are used to infer particular mixing patterns. At the South Fork of Brokenback Run in the Shenandoah National Park, Virginia, we have evidence that stream dynamics reflect a system composed of an ephemeral subsurface stormflow zone perched above a perennial water table Scanlon et al. 2000. The relationship between dissolved silica and stream discharge exhibits hysteresis in the clockwise (CW) direction. Modelling this relationship in the context of three-component mixing with constant-concentration end members failed to reproduce the observed c-Q pattern (Scanlon et al., In press). Temporal variation in soil-water concentrations of silica can explain how CW hysteresis loops in the c-Q curve can arise (Hornberger et al., In press). The CW loops that we observe in SFBR can be explained by time variability in soil-water concentrations only if the chemical (leaching) time constant is less than (or only slightly greater than) the hydrological time constant. The near equality of these time constants is consistent with reports from hydrological measurements and leaching experiments.

For this study, were one or more specimens collected and removed from the park but not destroyed during analyses?

No

Funding provided this reporting year by NPS:	Funding provided this reporting year by other sources:
0	30000

Fill out the following ONLY IF the National Park Service supported this project in this reporting year by providing money to a university or college

Full name of college or university:	Annual funding provided by NPS to university or college this reporting year:
N/A	0